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magnetron research at Scientific Research Institute No. 380 at Leningrad

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Attachment

A. HISTORICAL

State of magnetron research at ARNSTADT in early 1948, before departure of the German specialists thence to NII-380, LENINGRAD

1. (a) Before March 1948 various valves had been developed for 8 mm wavelength use. As Dr. PRAXMARER, the leader of this work, himself admitted, the work was going very badly. Of forty to fifty magnetrons produced, only four or five gave any output. This poor result was attributable to a lack of test instruments, making exact work impossible.

(b) Little was done towards fundamental cathode research, partly because Dr. PRAXMARER thought that he had a proper recipe for a cathode paste. He kept this recipe very secret; later in LENINGRAD it became very apparent that this paste was no good. A paste composition whose recipe was taken from the book "Oxykathode" by WEGNER and HERMANN, LEIPZIG, was patently better.

2. The magnetrons produced in ARNSTADT all had a cathode width of 30 to 35 mm. - i.e. the magnetic field had to have an air gap of 30 to 35 mm. The energy needed to achieve such a field was correspondingly great.

3. Experiments were also made to build magnetrons in the 3 and 5 mm range. These were not successful because the theoretical basis for such work was lacking. The existing magnets did not suffice, in an air gap of 30-35 mm, to attain the field needed for 3 and 5 mm magnetrons. Besides, the impulse generator only possessed an output of 50-60 kw and the power received could not be controlled. Nevertheless, Dr. PRAXMARER asserted that he had had 5 mm. magnetrons in operation.

B. CONTINUATION OF THE WORK IN NII-380

4. Organisation of the department responsible for magnetron work (see Appendix)

(a) PISKUNOV and Dr. PRAXMARER. Development of magnetrons.

(b) TRAUTMANN, KANTOR (?) and VASILEV. Building of the test instruments needed for testing the magnetrons, and actual testing of them.

/2.

(c) NOVIKOV and MENGS. Fitting and assembl magnetrons, production of cathode pastes; vacuum dept. and glass-blowing section.

(d) GUBIN, LORENZ and RIEDEL. Manufacture of the anodes.

(e) Klystrons and Radar - to be reported separately.

Development of the 8 mm magnetron - 1949

5. (a) By early 1949, the magnetron laboratory was so far equipped that development work could begin. The first task received from the Ministry was for the development of an 8 mm magnetron. The anode width of this magnetron was to be reduced from 35 to 18 mm. This meant a precision built cathode. The anode system was to be retained (24 slots in the anode: cathode diameter 4-5 mm). Corresponding to the larger capacity of the anode circuit, the inductivity of the circuits (Schwingkreise) (slots in the anode) was made somewhat smaller.

(b) Basic technical literature on these problems was lacking. The work of altering the anode slots went slowly forward into the unknown.

(c) There were many other difficulties in the way of this work. These difficulties took some 4 months to overcome. They included lack of equipment, shortages of chemicals and insufficient purity of the alcohols used (too large a water content). The oil pumps used had to be changed for mercury pumps to get pumps that would hold a vacuum of 10^{-6} mm. Additionally, many difficulties had to be overcome before completely satisfactory copper could be procured for the anodes.

6. Parallel with the development of the magnetron, work proceeded on the development of a 500 kw impulse generator, with the magnets and oscillographs needed to start the magnetron working.

7. (a) When the first magnetrons went to the test benches in about August 1949, it was soon apparent that they gave no output. Systematic development work then began. The anodes were turned (gedreht) in series of 8 to 10. Each of these anodes received the same number of slots and the width, length and depth of those could be varied in fractions of mm (0.2 - 0.4 mm). The diameter of the anode and cathode were also altered in special series. In this way, by late 1949, about 10 megnetrons had their cathode and anode dimensions so determined that the magnetrons gave some output.

(b) As there were at the time no output meters (Leistungs-messer) available, the output of these magnetrons was rated by the degree of illumination of a glow-lamp. Each magnetron was given a number (1 to 3): 1 meant 'very good' and 3 meant 'satisfactory'. Only two magnetrons were assessed as 1; as it turned out later (after two months) these magnetrons had an efficiency of 3%. This was of course much too small.

8. (a) Much better results obtained when the head of PISKUNOV's dept. procured the book "Microwaves". All the difficulties with which the specialists had hitherto unsuccessfully grappled were soon overcome with the aid of this book.

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The proper diameter of the anode and the cathode and the measurements for the slots were soon accurately determined.

(b) The large number of rejects that the Dept. had had was traced back to the bad fitting (Montage) of the cathode system. This fitting had become very difficult through the demand to fix the anode width at only 15 mm. Faults were mainly an asymmetrical placing of the cathode inside the anode and flashovers (Ueberschläge) inside the magnetron between the end plates (Stirnfläche) and the cathode.

(c) The fact that with the aid of "Microwaves" the specialists could achieve any success in the field of magnetron construction, although complete beginners in this field, is also attributable to the fact that the subsequent Director, MOISEEV, had produced two magnetrons with completely new types of slots and an efficiency of about 2%.

9. Up to December 1949, the tuning out (Auskopplung) of the HF energy was achieved through a coaxial line coupled either galvanically or inductively to the anode circuit. There was complete uncertainty about the mode of tuning out and the length and diameter of the lead, until the appearance of "Microwaves".

The 8 mm magnetron - 1950

10. At the beginning of 1950 the most important task of the laboratory was the development of a magnetron with a higher output. The construction of an output meter was necessary for this. This was made in about February/March 1950 and the output of the magnetrons already made could then be properly measured. It then became apparent that their output was very small: the best of them had an efficiency of 3-4% (cf para 7).

11. (a) Experiments were also made in early 1950 with magnetrons having 12, 18 and 22 slots. At the same time, a start was made with the building of a magnetron with wave guide output (Wellenleiterausgang). The dimensions of the wave guides were also taken from the book "Microwaves".

(b) After incorporation of these modifications, efficiency rose to 6%. Even this was too small. As measurements on a magnetron from MOSCOW showed, an efficiency of 8% for a normal 12 slot magnetron was attainable.

12. Work also proceeded in 1950 on cathode development. Cathodes were produced with a current density of 70 - 80 amp/cm^2.

13. In about August 1950, PISKUNOV received the data needed for the construction of a magnetron with an efficiency of 12%. It was thought by the Germans that these data came from MOSCOW. They were kept very secret by PISKUNOV. The magnetic (flux) (Magnetband) for this task was about 12,000 gauss.

The 4 mm Magnetron

14. (a) At the same time as the tasks for the development of the 8 mm magnetron were allotted, the Ministry suggested (empfahl) that HII-380 should begin preliminary experiments for the development of a 4 mm magnetron.

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(b) Three examples of the 4 mm instruments were made, of which one - surprisingly, to the Germans - was good. This one however, was lost, being shattered by an accidental blow which it received through PISKUNOV's clumsiness. 50X1-HUM

(c) The 4 mm magnetron had 48 slots.

Russian visitors to NII-380

15. PISKUNOV had frequent visits from the Ministry in MOSCOW and from officers of the Soviet Air Force. Visitors came every two or three months. PISKUNOV enjoyed these visits as occasions for demonstrations. For example, he would show the guests the impulse given by a magnetron, on a Braun tube, in rectangular form. This rectangular form of the impulse could always be held steady by a trick if one hunted (? - Uebersteuerte) the amplifier in the receiver. This hunted (?) shape was never the true output impulse. However, the visitors never saw through this deception but merely praised PISKUNOV for the good shape of the impulse.

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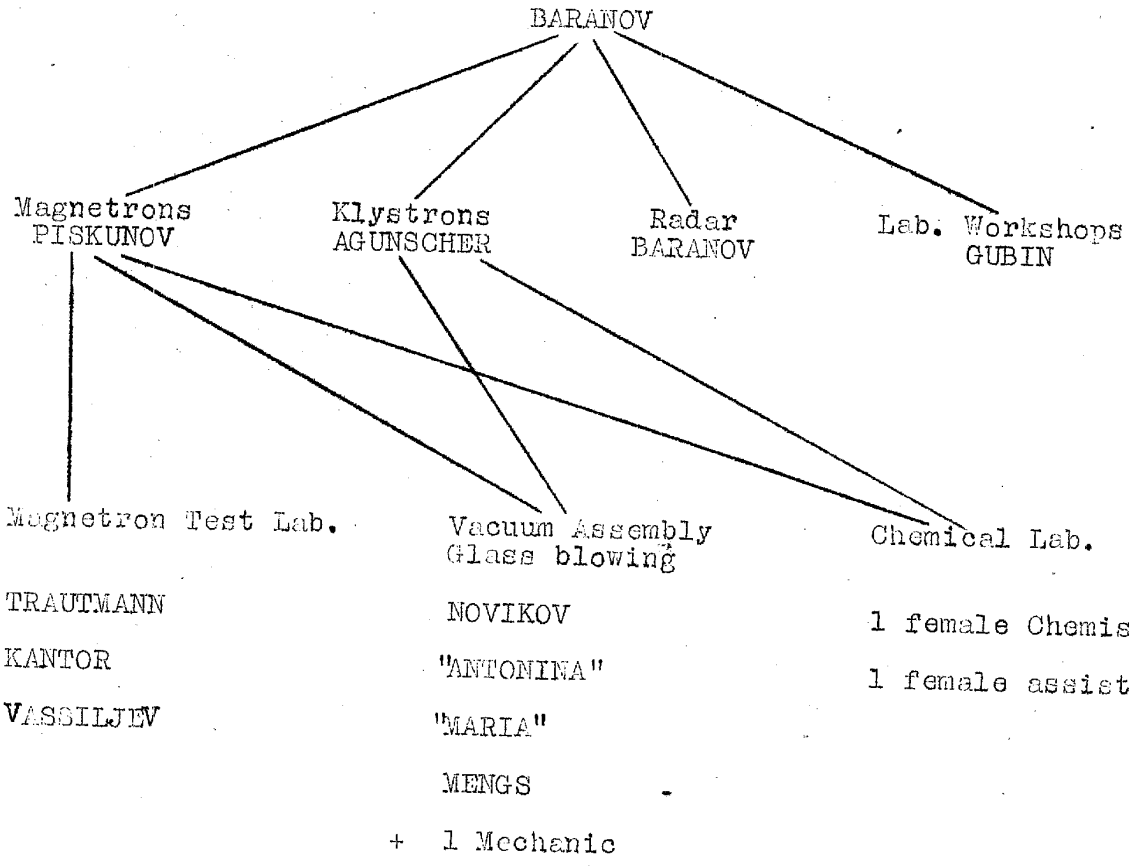
APPENDIX "C"

ORGANISATION OF BARANOV'S DEPT IN N.I.I.-380
(1950)



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